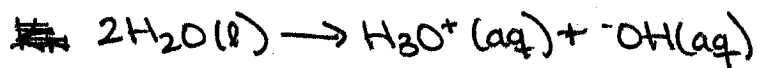


Worksheet: Ionization of Water, pH

Key

1. Write the ionization equation for water. Write the equilibrium expression for this reaction.



$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$$

2. What is the pH of a neutral solution?

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3. Calculate the pH of the following solutions:

a. $[\text{H}_3\text{O}^+] = 1.0 \times 10^{-10}$

$$\text{pH} = -\log(1.0 \times 10^{-10})$$

$$\boxed{\text{pH} = 10.00}$$

b. $[\text{H}_3\text{O}^+] = 1.0 \times 10^{-3}$

$$\text{pH} = -\log(1.0 \times 10^{-3})$$

$$\boxed{\text{pH} = 3.00}$$

c. $[\text{H}_3\text{O}^+] = 3.4 \times 10^{-12}$

$$\text{pH} = -\log(3.4 \times 10^{-12})$$

$$\boxed{\text{pH} = 11.47}$$

d. $[\text{H}_3\text{O}^+] = 8.7 \times 10^{-7}$

$$\text{pH} = -\log(8.7 \times 10^{-7})$$

$$\boxed{\text{pH} = 6.06}$$

e. $[\text{OH}^-] = 1.0 \times 10^{-3}$

$$1.0 \times 10^{-14} = (1.0 \times 10^{-3})[\text{H}_3\text{O}^+]$$

$$[\text{H}_3\text{O}^+] = 1.0 \times 10^{-11}$$

$$\text{pH} = -\log(1.0 \times 10^{-11})$$

$$\boxed{\text{pH} = 11.00}$$

f. $[\text{OH}^-] = 2.89 \times 10^{-9}$

$$1.0 \times 10^{-14} = (2.89 \times 10^{-9})[\text{H}_3\text{O}^+]$$

$$[\text{H}_3\text{O}^+] = 3.46 \times 10^{-6}$$

$$\text{pH} = -\log(3.46 \times 10^{-6})$$

$$\boxed{\text{pH} = 5.461}$$

4. Calculate the $[\text{OH}^-]$ of the following solutions:

a. $\text{pH} = 9.3$

$$[\text{H}_3\text{O}^+] = 10^{-9.3}$$

$$[\text{H}_3\text{O}^+] = 5. \times 10^{-10}$$

$$1.0 \times 10^{-14} = [\text{OH}^-](5. \times 10^{-10})$$

$$\boxed{[\text{OH}^-] = 2 \times 10^{-5} \text{ M}}$$

b. $[\text{H}_3\text{O}^+] = 1.0 \times 10^{-3}$

$$1.0 \times 10^{-14} = (1.0 \times 10^{-3})[\text{OH}^-]$$

$$\boxed{[\text{OH}^-] = 1.0 \times 10^{-11} \text{ M}}$$